

Group velocity delay technique for monitoring the density and composition of optically thick vapors

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Spectroscopic techniques are ideal for the characterization and process control of electron beam generated vapor plumes. Absorption based techniques work well for a wide variety of applications, but are difficult to apply to optically thick vapor plumes. We describe an approach for monitoring optically thick vapor plumes that is based on measuring the group velocity near an optical transition to determine the vapor density.¹ This technique has a larger dynamic range than absorption spectroscopy. We describe our progress towards a robust system to monitor aluminum in an industrial environment. Aluminum was chosen because of its prevalence in high performance aircraft alloys. In these applications composition control of the alloy constituents is critical to the deposition process. Data is presented demonstrating the dynamic range of the measurement. In addition preliminary data demonstrating aluminum vaporization rate control in an electron beam evaporator is presented. Alternative applications where this technique could be useful are discussed.

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¹ J. K. Crane, R. W. Presta, J. J. Christensen, J. D. Cooke, M. J. Shaw, M. A. Johnson, J. A. Paisner, Appl. Optics 30, 4289 (1991).